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GASES HEAVIER THAN LEAD

By Dr. Edwin E. Slosson.

Professor A. S. Eddington of Cambridge can spring more sensations in a half hour talk than any other sober-minded scientist I ever heard. He broke the record at the Toronto meeting of the British Association for the Advancement of Science when he expounded his new theory of the constitution and evolution of the stars. An old-fashioned physicist, if any such were in the lecture room, must have been shocked to hear him talk so calmly of gases more than fifty times heavier than platinum, of temperatures over twenty million degrees centigrade, of light waves that are lengthened by gravitation, of chemical elements losing their identity, of stars puffed out by the internal pressure of X-rays, of dwarf stars that are giants at heart, of gases made up of mere electrons and nuclei, of matter converted into energy, and of stars that are dissolving into light.

If these were mere speculations, such as some astronomers indulge in, Camille Flammarion for instance, nobody need mind, but Professor Eddington insists and persists in proving his points. He began by working out the mathematical theory of star formation on the assumption that its substance behaves like a perfect gas. Then on plotting the observational data of stars of all sorts these were found to fit closely to his theoretical curve, even our own sun which has a density one and a third times greater than water. From this he concludes that stars in general obey the laws of perfect gases, regardless of their density, and that their luminosity depends mainly upon their mass, the density making comparatively little difference.

Some stars seem to have a density heavier than platinum. For instance, the faint companion of Sirius has a mass eight-tenths as much as the sun, yet its size, as judged by its light, must be so small that its density should be fifty thousand times that of water. Whether its mass is really so great may be determined by observing the Einstein shift in its spectrum and this is now being tested at the Mt. Wilson Observatory.

The new theory conflicts with the theory advanced by Prof. H. N. Russell of Princeton and now commonly held, that stars start out in life as red giants of extreme tenuity, that heat develops as they contract, and that they get hotter as they lose heat, until they become white hot and then gradually cool down to red heat again. Prof. Russell, in spite of the fact that a hard blow has been dealt at the theory which had given him an international reputation, was the first to congratulate Prof. Eddington on his achievement. "I take off my hat to him," he said, "for this is the second time he has deduced from mathematical principles what ought to have been obvious but was not perceived before."

A possible agreement between the rival theories may be brought about by invoking Einstein's idea that matter may be converted into energy and radiated off into space. Professor Eddington says: "It is possible that a star may gradually diminish in mass during its evolution. This would happen if it obtains its energy of radiation by annihilating electrons and protons, thus burning itself away."

According to Professor Eddington's theory, stars continue to get hotter as they shrink until the central temperature is over ten million degrees Centigrade. At this heat the atom of the heavier elements would be stripped of its outer electrons and the atom of the lighter elements, like carbon and oxygen, would be reduced to the bare nucleus. The atoms in the stars would then have only about one hundred thousandth of the bulk of ordinary atoms, and such a gas could be compressed a hundred thousand times further than the gases we deal with on earth before the atoms begin to get crowded. In such a state all the stellar gases must have about the same molecular weight, 2.1, whatever may be the elements that compose them.

When I was young, astronomers used to try to scare us by telling us that the sun and stars were slowly cooling down and at length the universe would be left all dark and cold. That did not worry us enough, so now they have changed their tactics and prophesy a time when the elements shall melt with a fervent heat and the sun shall be no more. This sounds more alarming, for it would be worse for the human race to be roasted alive than frozen to death, and the idea that the solid ground may ultimately be dissipated into radiant energy and go rambling around a four-dimensional continuum forever gives one a new kind of shiver.

DISCOVER UNIVERSE'S LARGEST STARS 10,000 TIMES BRIGHTER THAN SUN

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The most conspicuous stars in the Magellanic Clouds are greater in size and in brightness than any of the giant stars heretofore known to astronomers, according to investigations just announced by Dr. Harlow Shapley, director of the Harvard College Observatory. Many of these stars are believed to excel the far-famed red giants Betelgeux and Antares, and in diameter probably approach the diameter of the orbit of Jupiter, some 966,600,000 miles.

Extensive photometric work has led finally to the determination of the distance of the Small Magellanic Cloud. Similar investigations are under way for the Large Cloud. These stellar systems, which are visible only in southern latitudes, derived their name from descriptions given four hundred years ago by the navigator Magellan. They look like large patches of the Milky Way, but are quite detached from the Galaxy.

Through a prolonged study of the variable stars discovered in the Magellanic Cloud by Miss Leavitt at the Harvard Observatory twenty years ago, a method has been developed for the determination of the distances of star clouds and clusters. Only this year, however, has it been possible to give a decisive value for the magnitudes of the stars in the Small Magellanic Cloud, and consequently to measure the distance and dimensions of the system. It is now found that the diameter of this Cloud is sixty-five hundred light years. The distance from the earth is thirty-two kiloparsecs, which is equivalent to a little over a hundred thousand light years. A star of the luminosity of our sun would at this distance be of the twenty-third magnitude.

Stars as faint as our sun in this cloud, however, are far beyond the range of modern telescopes. The studies of brightness on the Harvard photographs, which were made at the Arequipa station in Peru, go down only to the stars of the eighteenth magnitude.

More than half a million stars that are at least a hundred times as luminous as our sun are contained in the Small Magellanic Cloud. A few hundred of them have each more than ten thousand times the solar brightness. The very brightest of the super-giants are shown by photographs of their spectra to be of the redder classes of color. Hence the intensity of light emission must be low, and, to account for such high total brightness, the dimensions must be exceedingly great. It is calculated that the diameters of the largest super-giants are nearly a thousand million miles. This is at least three or four times the diameter of Betelgeux, and is probably very near the maximum diameter possible for a luminous star.

The Small Magellanic Cloud is known to be receding from the Galaxy with the enormous velocity of a hundred miles a second. Dr. Shapley points out that almost certainly both the clouds of Magellan were in the Milky Way at a time more recent than the paleozoic era, and were then indistinguishable from the other star clouds of the Milky Way.

DANISH EXPLORER DESCRIBES ANCIENT CULTURE OF ESKIMO

Knud Rasmussen, the noted Danish Arctic explorer, has just emerged from a nine-months' trans-continental trip through Eskimo country hitherto totally unexplored, according to information wired from Kotzebue, Alaska. Scientific information of unprecedented importance concerning the history, customs, religion and language of these northern peoples will be made available as soon as Mr. Rasmussen has had time to edit the twenty volumes of Eskimo folklore he brings with him, and to arrange the great collection of photographs and motion pictures which members of his party have taken.

One of the most significant discoveries made during the exploration was in regard to the Eskimo language. The Greenlandic dialect, which Mr. Rasmussen speaks fluently, was readily understood by Eskimos all the way from the Magnetic North Pole, on the Boothia Peninsula, to the shores of the Bering Sea. This is the more remarkable in that many of these Eskimos not only had never seen a white man but did not even have any dealings with their nearest Eskimo neighbors. This is taken, of course, as conclusive evidence of a close kinship among all Eskimo peoples.

Other evidences of a common origin and common culture were found in the similarity of implements and weapons used by all the tribes, and in archeological investigations made in a number of places. In the territory of one hitherto unvisited tribe in King William Land the party unearthed a collection of seventy houses built of whale bones, stones and sod.

Over five million fish eggs and 160,000 fry were planted in the streams of Yellowstone National Park during July of this year.

TRICK CHAIR TESTS FEAR REACTIONS

The collapse of a faulty chair in which he was seated during a class period at the University of Chicago and his consequent tumble to the floor have been turned to good account by Dr. W. E. Blatz of the psychology department. Remembering his own sensations as he clutched at his desk for support, Doctor Blatz has devised and put into effect a scheme for arousing the emotion of fear and controlling it for experimental purposes.

The scheme takes the form of a specially constructed chair which will collapse and let the occupant drop suddenly when an electric switch is turned. As the chair is heavily upholstered no injury results but fear is aroused in the mind of the subject as falling, or loss of bodily support, is one of the two fundamental ways in which fear is created.

Unaware of what is about to take place, the subject acts as he would naturally if the drop were not prearranged. His heart beats faster, breathing becomes more rapid and he grasps for support. Electrodes, fastened to the subject's chest, are connected with an electrocardiograph in another room, which records in detail the effect on his heart beat and the change in his electrical state before, during, and after the fall of the chair. An electrical pneumograph records the effect on his respiration.

The same experiment is tried a second, third, and fourth times. Knowledge of what is to happen results in the subject making no effort to save himself and he maintains that he no longer has any fear during the test, but the recording instruments prove that the heart still beats faster and the breathing is more rapid.

Doctor Blatz believes that the experiment may some day develop a method of studying, diagnosing, and treating emotional abnormalities which are conducive to certain forms of insanity.

The twenty-five students who underwent the test proved themselves "good sports" Each refrained from telling those who had not yet undergone the experiment what was about to happen.

BATH FOR SEEDS SPEEDS UP GROWTH

Soaking garden seeds to give them a running start also increases their speed through life, according to reports from the Plant Breeding Station at Proskau, Germany. Radish seed soaked for two or three hours in solutions of magnesium chloride or magnesium sulphate gave an increase in leaf and root development and a more than trebled yield in the most striking of the treated plants. Even soaking in pure water more than doubled the yield.

Officials of the U. S. Department of Agriculture stated today that simply taking precautions to start with disease-free seed may lead to a false impression of stimulated growth. The Department has been studying the effects of chemicals in destroying seed-borne parasites. Treated seeds may lead to normal healthy plants and such merely healthy plants may give the impression of leading a faster life when compared with sister plants from untreated seed.

The Department of Agriculture is now launched on experiments which will determine whether there is a genuine speeding-up of the life of plants from the soaking of seed as the Proskau experiments suggest.

SENSITIVE MECHANISM OPERATES WITH SUPERHUMAN ACCURACY

A mechanical device so sensitive to pressure that the breath of a child directed into a funnel can release enough power to lift many tons of weight, and so sensitive to temperature that the heat coming from a man's hand held near a metal strip will effect the same result, has been perfected in Sweden after three years of experimentation and through tests in actual use.

This remarkable multiplication of power is, however, only an incidental feature of the apparatus, which takes the place of a man in an industrial establishment opening and shutting all sorts of regulating valves automatically and with an accuracy that no human being could ever achieve. The new apparatus can, for example, keep the temperature of a room within a quarter of a degree of the value desired, and can keep steam pressure from changing more than two ounces per square inch. It can also regulate electric current, speed, dampness or dryness, density of liquids, viscosity, and vacuum.

This new regulator, which was invented by the Swedish engineer, Ragnar Carlstedt, is based on one of the simplest of all mechanical principles, namely the harnessing of a flowing current of water. In other words, if it is desired to open or shut the valve of a steam radiator in a room, this work is done by turning on water pressure from one of the water pipes of the house, instead of turning the valve by hand.

But how does the regulator know when and how to turn this valve? The operation of the apparatus may be explained as follows: A thin strip of ebonite, which contracts or expands under the slightest change of temperature is so mounted that any change in its length moves a lever up or down. Meanwhile a jet from the water current already referred to is constantly playing against the moving end of the lever, which really acts as a lid over the jet, hindering its free flow more or less. If the jet is completely stopped, for example, the water backs up in the pipe until the pressure is strong enough to open a little valve, and this little valve sets free a current of water sufficiently strong to work the valve of the steam radiator. This final work is accomplished through a simple piston and cylinder mechanism. Even though the playing jet of water be not completely stopped, but only hindered in the slightest degree, it will set into operation a corresponding degree of power, thus regulating the steam radiator valve just enough to raise or lower the temperature of the room as little as desired.

Whatever use the regulator is put to its main operating mechanism remains the same, while the so-called impulse receiver is adapted to the force or condition which is to be regulated. For steadying temperature the impulse receiver, as we have just explained, is a strip of ebonite. For maintaining an even amount of dampness in a tobacco factory, for example, a band of cotton threads takes the place of the ebonite, and, by contracting or being extended under the changes of humidity works the lever which hinders the jet of water, etc. For regulating steam pressure in a power plant the impulse receiver is a cylindrical copper bellows which is connected with the steam pipe in which the pressure is to be regulated.

Tests of zinc roofings, conducted by the U. S. Bureau of Standards, show that they fail not by breaking but by bending slowly under load, the material taking a permanent set.

WILL URGE FASTER MAPPING OF WORLD

Nations with large unmapped areas will be urged to hasten their topographical work so that the resources of the world may be more fully understood, in a proposal which the American Geophysical Union will present before the general assembly of the International Geodetic and Geophysical Union at Madrid in October. Geophysical investigations are hampered greatly in countries which have not been mapped topographically. Further international cooperation in determining the configuration of ocean basins will be discussed by the Union. A more accurate knowledge of the bottom of the sea is declared the foundation of all future geophysics in the preliminary outline of the discussion.

HAY-DIGESTING GERM FOUND IN HUMAN BODY

A hitherto unknown member of the bacterial garden that each human being keeps in his digestive tract has been isolated and studied by a woman worker, Madame Khouvine, at the Pasteur Institute. It is of peculiar interest because it possesses the power to digest cellulose, the cell-wall material of hay, soft wood, and other "roughage". Cellulose-digesting bacteria have long been known to exist in the intestines of grazing and browsing animals; indeed, it is believed that it is due to a sort of partnership between the bacterium and the host-animal that hoofed animals are able to derive nourishment from hay - and even, in the case of the goat and the camel, from wood and paper. But so far human beings have never been suspected of being even potentially "hay-burners".

It is not suggested in the present instance that the new bacterium will enable man to combat the high cost of living by eating cotton stalks or ensilage. The microbe digests the cellulose pretty thoroughly on its own account, and the by-products of its activities have little or no value as food. They are listed as

"carbon dioxid, hydrogen, alcohol, and acetic and butyric acids". Apparently it must have cellulose for food, for it cannot make use of sugars or starches.

While the new germ apparently does not do us any good, it seems also incapable of harm. Mme. Khouvine states that it is non-pathogenic.

DROWNING OUT RICE-FIELD WEEDS

The dikes of Holland are given credit for the long immunity of that country from invasion by enemies. Would-be conquerors are restrained by the reflection that their armies can be drowned, while the amphibious Dutchmen could live through the floods that they would turn loose. A philosophy of the same sort is at the bottom of a new method of combating the weeds in California rice-fields, worked out at the California Experiment Station at Cortena. The old method of irrigation, which consisted in flooding and draining the land at intervals until the rice was well sprouted, permitted the weeds to get a start as well, and like the corn and the cockle in the parable they grew together until the harvest - with the weeds having decidedly the better of the argument. But rice seed will germinate under water, and weeds will not; so the rice growers of the region are now flooding their land to a depth of from four to eight inches at the very outset and leaving it that way, with the result that the rice thrives and the weeds perish.

SCIENTISTS SHOW WHERE ROOTS GET AIR TO BREATHE

Plants breathe with their feet as well as with their heads, and there is oxygen enough in good garden soil for their needs. These are discoveries of Prof. Burton E. Livingston of the Johns Hopkins University and Dr. Lee M. Hutchins of the U. S. Department of Agriculture, working in the former's laboratory of plant physiology.

Earlier work by these men and by other scientists had already established the fact that plants must get their oxygen through their roots as well as through their leaves, and that air taken in through the top of the plant does the roots little or no good in most species. It has, of course, been long observed that many kinds of plants "drown" when they stand for a considerable period of time in flooded land, even though their tops may be above the water. This "drowning" of a plant is exactly like the drowning of a man: both die of suffocation, or lack of oxygen. That the plant has its head above water does it no good; it has no lungs or circulatory system to pass the air down to its roots, and if they can not get oxygen from the soil they can not get it at all.

Livingston and Hutchins then proceeded to develop a most ingenious method for measuring how much oxygen the soil can supply in a given time. A cone-shaped filter of thin porous porcelain is sunk into the soil to be studied, and allowed to remain until the earth settles around it. Then nitrogen, from which the last trace of oxygen has been extracted, is fed slowly through from a storage tank, and as it passes out again is run through a "sikytu" solution of pyrogallol, a chemical that turns brown in the presence of oxygen, and can be used to measure the amount that has come in through the walls of the filter.

By this method it was found that three factors influence the rate at which oxygen can pass through the soil to the roots of plants. Tightly packed soils can supply little oxygen, while well-cultivated soils pass it through easily. The rate of supply depends also on the amount of water present: the more nearly water logged the soil the lower the rate of oxygen movement. Finally, the deeper the soil level the slower is the rate of supply.

The natural distribution of plants is governed at least in part by the amount of oxygen their roots need. Plants of wet habitats, like rice, willows and cattails, require little oxygen for their roots; corn, potatoes and other crops of well-cultivated lands require a great deal. Ordinary forest trees for the most part occupy an intermediate position. It is expected that the new method will in time yield data of great value in botany, agriculture and forestry.

YELLOW FEVER NOW MAKING LAST STAND

Yellow fever is making its last stand in the Western hemisphere.

Entirely eliminated from the West Coast of South America and Mexico it still persists in Colombia and northern Brazil, where work of the Rockefeller Institute now is being centered.

Nicaragua and Guatemala, once pest holes, have not reported a single case since 1921. Control operations were formally closed in Mexico last year. British Honduras has not had a case for four years.

MOSQUITOES THRIVE IN WARM WEATHER

Mosquitoes like hot weather.

Observations in the salt marshes and woodlands near Barnegat, N.J., according to the New Jersey Statistical Bulletin, prove that the hotter it gets the more active they become.

"Below 60 degrees Fahrenheit," says the bulletin, "their activities decrease rapidly and almost stop below 50 degrees.

"A temperature between 68 and 77 degrees has the greatest accelerating influence upon the rate of their activities. The influence of wind upon the rate of alighting becomes apparent with a wind velocity between 4 and 8 miles an hour, while the rate of alighting with a wind velocity above 8 miles an hour is constant in spite of increasing temperature, so that wind velocity overcomes the influence of temperature. The number of mosquitoes alighting increases in almost line fashion with the increase of relative humidity up to 85 per cent; from 85 to 95 per cent relative humidity the numbers alighting remain nearly constant. The percentage caught of those alighting, which indicates degree of general activity, increases rapidly with the relative humidities below 75 per cent; it remains constant from 75 to 85 per cent relative humidity and decreases slowly from 85 to 95 per cent relative humidity.

"Extremely high humidities are detrimental to the general activities of the insects. Higher light intensities seem to stimulate the activities of these species of mosquitoes. Previous precipitation seems to influence the vigor of biting and troublesomeness of these species of mosquitoes. Prolonged showers and heavy rainfall decrease the numbers of mosquitoes on the wing."

COST OF INHERITED BLINDNESS HIGH

At least 85 eye defects are hereditary. At least eight of them are apt to produce practical blindness. From 5,000 to 7,500 persons in the United States now are blind from hereditary defects and their care costs more than \$2,000,000 a year, it is estimated.

These figures are obtained from the report of the committee on hereditary blindness of the American Medical Association, which has studied the subject for the past three years.

The committee suggests a legal requirement that persons afflicted with hereditary eye defects be required to give bond at the time of marriage sufficient to cover the cost of caring for possible children who might become burdens on the community.

NEW INSTRUMENT MAY LOCATE OLD TOMBS

Tombs exceeding in splendor that of Tutankhamen may be detected in the Valley of Kings by the use of the Eotvos torsion gravity balance, which detects small irregularities in the gravitational pull of the earth. The instrument has been used successfully in detecting oil and ore deposits, among them the largest known body of iron ore in Russia. Two English scientists, E.H. Rayner and T. Smith, suggest that such a large cavity as the tomb of Tutankhamen would reveal its presence, although buried under many feet of rock and sand.

TREES CAN'T BREATHE SMOKE AND LIVE

Trees can not breathe smoke and be healthy.

Away from the fresh winds of the great open spaces they droop and die like country maidens.

Such has been the experience, at least, of the St. Louis municipal park department. Efforts to establish trees within the smoke area created by the industries of the city, which includes some of the most prominent public buildings, are proving failures.

Sycamores and poplars, supposedly smoke resistant, succumb within two or three years. The only tree which seems to thrive in such localities, a veritable child of the slums as it were, is the Tree-of-Heaven, or Ailanthus.

Shrubs show much the same tendency. Privet has proved the most resistant - but even this is dying out. Lilacs, when they live, seldom bloom. Blue grass lawns are impossible except for a short period in spring.

Evergreens have proved unable to endure the smoke. Trees that formerly flourished are dying as the smoke area is extended. The oaks in one of the principal city parks are dying rapidly, indicating that the smoke has reached them, although it is not noticeable otherwise.

The St. Louis officials have decided that, after all, the city is no place for healthy shrubs.

GERMAN ACID TREATMENT IMPROVES COTTON CLOTH

At a meeting of leading German industrial chemists a discovery was announced that is expected to have far-reaching effects in all branches of cotton manufacture. The essential step in the process is a treatment of the cotton in highly concentrated nitric acid. This causes the fibers to contract and curl up, so that they come to resemble wool both in appearance and in their lowered heat conductivity. At the same time there is a gain in coloring properties, tensile strength and elasticity. It is claimed that after the acid has been removed no detrimental effects remain. One large cotton-spinning and dyeing concern in Germany is already making a large-scale application of the new process.

SEES FUTURE FACTORIES GROWING OWN FUEL

Does the photo-electric process of accelerating plant growth contain the answer to the future power and fuel problems of the world?

No less an engineer than E. W. Rice, jr., honorary chairman of the directors of the General Electric Co., raised this question in an address before the World Power Conference in London recently.

In other words, is there a prospect of industry creating forests fast enough to supply its furnaces?

Mr. Rice said: -

"Sunlight, including all radiation from the sun, is the source of our commercial power, no matter what the intermediate agent - coal, oil, water or wind. The direct transformation of solar radiation has been sought, but it is probably too intermittent because of the cycle of night and day and the intervention of clouds to be utilized directly. The most promising solution would seem to come through storage in growing vegetation. Improved methods of selection and of the acceleration of such vegeto-chemical storage of the sun's radiation may be discovered and should be diligently sought.

"It has been suggested that the photo-electric process may contain the germ. Such phenomena should be investigated, if for no other reason than that we are here dealing with the electron."

The oft-made proposal to drill a hole ten to twelve miles deep through the earth's crust with the object of utilizing the heat of the globe in producing power, also was endorsed by Mr. Rice.

Whether the project proved practical or not, he said, the cost would be trivial (less than that of a single battleship) compared with the information that might be gained by investigation of this unexplored region of the earth.

The project is worth undertaking, he said, as an international scientific enterprise.

TABLOID BOOK REVIEW

CHEMISTRY APPLIED TO HOME AND COMMUNITY. A Textbook and Laboratory Manual. By Pauline G. Beery, Assistant Professor of Chemistry. Pennsylvania State College. Philadelphia: J. B. Kippincott Company.

A remarkable textbook; one that is really readable. Open it anywhere and your eye will catch an interesting item, a curious fact, a household hint, a bit of history, a biographical anecdote or a literary quotation. For the author realizes the importance of historical perspective and human interest. She does not disdain to tell about the composition of cosmetics, the removal of stains, the testing of textiles, the fastness of dyes, the balancing of dietaries, the beauty of pottery and other topics of particular interest to women. The questions and topics for additional consideration are stimulating and pertinent, and the references for further reading in books and periodicals are exceptionally full and up-to-date. With this book on a handy shelf, the librarian or teacher will be ready with an answer or a reference to the practical questions put to her.

A hay laboratory has been established by the U. S. Department of Agriculture at Kansas City.

The National Park Service is giving away buffaloes to municipalities and other public organizations that will pay for the cost of capture and transportation from Yellowstone Park.
